

## Durham Research Online

---

### Deposited in DRO:

18 November 2016

### Version of attached file:

Accepted Version

### Peer-review status of attached file:

Peer-reviewed

### Citation for published item:

Townshend, T.G. and Gallo, R. G. and Lake, A.A. (2015) 'Obesogenic built environment : concepts and complexities.', in The Routledge handbook of planning for health and well-being: Shaping a sustainable and healthy future. Abingdon: Routledge, pp. 199-210.

### Further information on publisher's website:

<https://www.routledge.com/9781138023307>

### Publisher's copyright statement:

This is an Accepted Manuscript of a book chapter published by Routledge in The Routledge handbook of planning for health and well-being: Shaping a sustainable and healthy future on 12/06/2015 available online:  
<https://www.routledge.com/9781138023307>

### Additional information:

## Use policy

---

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a [link](#) is made to the metadata record in DRO
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Please consult the [full DRO policy](#) for further details.

# **Obesogenic Built Environment: Concepts and Complexities**

Tim G Townshend, Rachel Gallo and Amelia A Lake

## **INTRODUCTION: OBESITY IS A GLOBAL COMCERN**

Obesity is an issue of global concern. Obesity rates have risen rapidly in the recent past with an associated increase in a number of related serious health conditions. While the basic equation behind human obesity seems simple – too much energy consumed, too little energy expended – the causes are complex and multi-factorial, including biological, psychological, sociological and economic influences. Swinburn et al coined the term ‘obesogenic environment’ as the ‘sum of influences, opportunities, or conditions of life’ that promote obesity in individuals or populations (1999), an all-encompassing concept that includes the built environment. While establishing causal pathways between the built environment and obesity has been notoriously difficult, the Foresight report (2007) suggested there was enough expert evidence to implicate the built environment in the obesity crisis – calling for greater consideration of the issue in urban planning.

This chapter will review the evidence around the concept of an obesogenic built environment and explore why the evidence has been so difficult to capture, why it is time to act on the evidence we have (even if partial) and how urban planning might contribute to amelioration of the obesity crisis.

## **A complex issue**

Before looking at the evidence that links the built environment and obesity, it is important to briefly outline why obesity is a significant concern and what the complexities of the issue are. Obesity was highlighted by the World Health Organisation as a ‘global epidemic’ at the start of the 21<sup>st</sup> Century (WHO 2000). It is significant because it is recognised as a major risk factor in a number of serious health conditions, such as type 2 diabetes, coronary heart disease and certain cancers. The most common way to measure a state of being overweight or obese is based on body mass index (BMI), using the equation  $\text{weight (kg)} / [\text{height (m)}]^2$ . For adults, a BMI of over 25 is considered overweight and over 30 is classified as obese.<sup>i</sup> Obesity in children and adolescents is of particular concern, since weight problems at a younger age tend to ‘track’ through to adulthood.

In the UK in 2007 a key report by Foresight highlighted that while people had not altered biologically by comparison with previous generations, the ways we live – for example work patterns, transportation, food production and the way we purchase food – have changed radically over the past five decades (Foresight 2007). Many of these changes have exposed people to an underlying, often inherent, biological tendency, that is, to gain weight. However, underlying this seemingly simple problem is a complex set of interrelationships between a myriad of variables, both individual and environmental. This complexity is captured in Foresight’s obesity ‘system map’, a conceptual representation which was constructed using available evidence from experts in relevant disciplines. The system map is useful in many ways, not least in that it demonstrates that trying to establish simple cause and effect relationships within the system is unlikely to be possible. This creates an epistemological challenge around what can be established with certainty, what we treat as ‘evidence’ and how we respond to it. This is important not least because both public health and planning policy

increasingly call for evidence to underpin them (with different interpretations of what evidence should demonstrate) – we will return to this important issue in the concluding section.

While this chapter uses the UK situation and the way the planning system in the UK might respond to the country's obesity problem as an example, this is very much a part of the global crisis (Delpuech et al 2009) and generic conclusions can be drawn that are universally applicable. Of particular concern are soaring obesity rates, particularly among the newly established middle classes, in large parts of the rapidly developing and newly industrialised world over the past decade. As personal wealth has increased individuals' diets in countries such as India and China have changed, with higher meat and dairy content, while at the same time these countries have increasingly adopted developed world approaches to transport and urban development. Active travel (walking and cycling) has declined as ownership of private vehicles has burgeoned and suburban built forms more usually associated with western countries, have become the norm (Bell et al 2002; Reynolds et al 2007; James et al 2010).

## **FOOD AND THE BUILT ENVIRONMENT: CURRENT EVIDENCE**

Importantly, the built environment has the potential to influence both sides of the energy (im)balance that leads in humans to becoming overweight and obese. The places we live, work, go to school and so on can either provide, or constrain, opportunities for physical activity and for healthy and unhealthy food access. The Foresight report cited above found that there was enough expert evidence to implicate the built environment in the obesity crisis; the rest of this section will review current evidence.

The way in which we obtain food has changed radically in recent decades. The ‘food environment’ includes any opportunity to obtain food and is influenced by socio-economic, cultural, and policy factors at all levels (Lake and Townshend 2006). On an everyday level, therefore, the food environment encompasses a mixture of shops and supermarkets, where we buy food for home consumption; as well as cafes, takeaways and restaurants and even vending machines at our schools, places of work and leisure venues— where food for consumption mainly outside the home is purchased. Food environments therefore encompass what food is available, what it costs, how it is promoted and so on – Figure 14.1 (Lake et al 2014).

**INSERT FIGURE 14.1 ABOUT HERE**

**Figure 14.1: The food environment includes availability and promotion**

**Source: authors**

The types of food implicated in health problems are well-established – those high in saturated fats, sugars and salt (WHO 2003). However the exact pathways between the availability of these types of food, our propensity to consume them and therefore, their health consequences, are actually less well understood. The evidence that can help to unpick the environmental influence on individual diet is very much in its infancy. Furthermore, the food environments in different countries can be vastly different, so that findings from one country are not easily translated to other contexts. Examples of this are so-called ‘food deserts’ – areas where affordable healthy food is difficult to obtain: research in the US found a clear link between

the existence of food deserts, diet and health, but these relationships have not been found in the UK.

A recent review of 38 studies that looked at the evidence of a relationship between food environments and diet (mostly examining the consumption patterns for certain food groups – such as fruits and vegetables) suggested there is moderate evidence to support the hypothesis that food environments influence dietary health (Caspi et al 2012). Caspi et al suggest that evidence relating to fast food was weakest; however, evidence is mounting. In England research has reported that the availability of fast-food outlets around secondary schools can be an obstacle to establishing healthy eating habits (Smith et al 2013). Recent research has established that there is link between fastfood availability and obesity in older children (Cetateanu and Jones 2014).

Some studies have attempted to measure weight status in relation to food access and neighbourhood. Black and Macinko's review of 37 studies pre-2007, while finding there to be inconsistency in the relationship between obesity and the availability of healthy and unhealthy food, also noted that the measures used to assess local food environments were generally inadequate (Black and Macinko 2008). Another issue with many studies (including those examined by Black and Macinko) is that they only explore food access and availability around address of residence – however these don't take into account the other places where people spend large amounts of time, such as work, leisure, or the environments they pass through when travelling to and from work (Burgoine and Monsivais 2013).

Some local authorities have attempted interventions to tackle the proliferation of takeaway food outlets in the built environment. For example, the London Borough of Barking and

Dagenham's 'Saturation Point' policy includes exclusion zones for new takeaways within 400m of a primary or secondary school, restricting clustering by allowing no more than 5% of units as takeaways within retail centres and no more than two adjacent to one another. In addition, where takeaways are granted planning permission, a one off £1,000 charge is levied from them to go towards obesity amelioration initiatives, such as improving children's play areas (London Borough of Barking and Dagenham 2009). Since its adoption, the policy has had some success, including the refusal for a well-known pizza chain to open a premises in a retail location, on the grounds that it was both within a 400 m exclusion zone and would result in exceeding the acceptable amount of shop frontage allowed for takeaways. The decision to refuse was upheld on appeal. However, this policy and similar ones adopted by other councils have not always been upheld during the planning appeals procedure. This suggests that the UK Planning Inspectorate is giving less weight to these kinds of policies than to other planning considerations, for example, policies for maintaining retail frontage (Lake et al 2014). This is of concern and an issue we return to at the end of this chapter.

In comparison to the built environment's role in providing exposure to unhealthy food choices, opportunities to provide healthy food exposure are even less well researched. For example there is evidence from the USA that adults with access to an allotment, or community garden, consume more fruit and vegetables (Alaimo et al 2008) – Figure 14.2 - and community gardens have been used to improve the diet of poor communities, particularly in the developing world. More generally there is evidence to suggest allotments and community gardens increase social capital among communities and therefore benefits accrued to diet may spread beyond immediate gardeners and their families as friends and families share in excess produce. Allotments also promote active lifestyles and mental wellbeing (van den Berg et al 2010) which are in turn linked to better diet (McCormack et al

2010). There are no known studies that link these opportunities to weight management/obesity prevention and other health outcomes; however, some local authorities are linking allotment provision with health aspirations. The London Borough of Brent's food and allotments strategy, for example, links promoting the benefits of food growing and healthy eating through school cookery classes (2012).

### **INSERT FIGURE 14.2 ABOUT HERE**

**Figure 14.2: Adults with access to a community garden, or allotment consume more fruit and vegetables**

**Source: authors**

In summary, environmental exposures in terms of the availability and accessibility of food interact with our individual food preferences to drive food choice. The relationship between the food environment and obesity is complex; however understanding the relationship between what we eat and the environmental context in which food choices are made is essential to the development of sustainable obesity prevention strategies. In parallel we need to develop our understanding of how the built environment fits into the obesity equation through providing or hindering food access. As stated earlier, achieving either of these objectives will not be an easy task and may be many years away. In the meantime, further damage to communities' health may be caused if action is not taken. We need to take planning decisions/create policy on the evidence base we have, an issue that we return to in our final discussion and conclusion section.

## **PHYSICAL ACTIVITY AND THE BUILT ENVIRONMENT: THE EVIDENCE**



The built environment can either provide opportunities for, or place constraints upon, physical activity. This has two aspects: ‘active travel’ – that is, travel which involves human effort (walking, cycling, skateboarding and so on) as opposed to motorised transportation (see also Chapter 2.3 Active Travel); and active leisure, such as gardening or playing sports. If someone lives in a neighbourhood where the daily requirements of life, shops, services, schools, workplaces and so on are nearby, this may encourage them to opt for active travel. Having access to greenspaces, parks, riverside walks, nature reserves and similar places, is likely to encourage walking and cycling for leisure, as well as other physical activity, such as playing games and sports (Giles-Corti et al 2005). The fact that the built environment provides opportunities for physical activity is therefore significant since we know exercise is important to help individuals maintain a healthy weight.

As with food environments, however, causal networks between the built environment and health outcomes are extremely complex. Research suggests that living in greener neighbourhoods is correlated with greater wellbeing and lower levels of ill-health. One suggested mechanism is that greener neighbourhoods encourage more active travel and greater physical activity in leisure time (Giles-Corti et al 2005; Tilt et al 2007); though not all studies have shown this relationship. Again there is a huge amount of complexity around this issue and research is on-going (De Vries 2010).

There has been a raft of studies that attempted to *correlate* neighbourhood level factors to walking – mostly it should be noted from the US. These have generally associated ‘walkability’ with higher residential density, mixed land uses, well-connected street patterns,

good access to public transport and a safe, comfortable and attractive public realm (Townshend 2014a). A number of studies have further attempted to correlate walkability in the built environment with weight status (mostly BMI). Black and Macinko's (2008) review of pre-2007 studies found that neighbourhoods which displayed barriers to physical activity were associated with increased BMI. However a more recent review, while finding increased physical activity in walkable neighbourhoods, counter-intuitively found that BMI was generally unaffected (Durand et al 2011).

While useful, the reviews mainly draw on research that was, as stated, located in North America, or Australia. More useful for discussion here is evidence from Europe. A key study here is provided by Barton et al (2012) which presented evidence from 12 suburban/commuter locations in four English city regions: London, Newcastle, Cambridge and Bristol. This study generally supported earlier findings, in that where local facilities are provided within walking distance, they are used and moreover, contrary to common belief people walked considerable distances in these areas. However, a key point the researchers emphasised is that mode of travel varied hugely between areas – for example active travel even for local trips ranged between 29% and 64% of trips. This modal breakdown reflected a diversity of local area factors: accessibility of facilities, the quality of the public realm, the socio-demographic profile of the local population, along with local cultural and behavioural norms. It drew the researchers to conclude that the unique nature of places could not be 'reduced to one or two convenient variables' to explain differences in behaviour (ibid. :196). There were shared patterns for active travel, for example, proximity of shops and services was clearly important in generating trips, but there were also many complex exceptions, meaning that making generalisations about 'suburban' or any other type of area may be very

misleading; this particular aspect of complexity is returned to below in relation to work undertaken at Newcastle University.

Another key finding of the research reviewed above was that more recent suburbs – those developed in the last 20–30 years – displayed more car dependence than older ones, Figure 14.3, suggesting that while planning policy in the recent past has promoted neighbourhoods which are more sustainable and healthy, what has been delivered on the ground seems to be very different. These points are made elsewhere (Townshend and Lake 2009) that, firstly, although many new housing developments are built to densities that would support local shops and services, in practice these are often lacking; and, secondly, even if land-uses are mixed, land uses such as warehousing or drive-through restaurants may not generate much active travel.

**INSERT FIGURE 14.3 ABOUT HERE**

**Figure 14.3: Great Park, Newcastle, is largely car dependant**

**Source: authors**

The picture across older suburbs is also complex. Over the past two decades our shopping habits have transformed. In wealthier suburbs traditional, grocers, butchers and bakers have been replaced by coffee shops, delis and shops selling upmarket ‘knickknacks’. However, in may lower socio-economic status (SES) neighbourhoods the situation is very different.

Declining traditional retailing has given way to a toxic mix of fast-food takeaways, ‘pay-day’

loan outlets and betting shops. Therefore, the problems of fast food outlined in the first part of section 3.6.3 are compounded by other unhealthy services associated with mental and physical health problems (Townshend 2014b). The benefits of generating active travel in such areas may therefore be outweighed by the unhealthy nature of what is on offer there: this is an issue planning urgently needs to address in the UK and should be a warning to other countries following a similar trajectory.

### **Self-selection**

No review of obesogenic environments would be complete without some commentary on the issue of self-selection. Self-selection is the notion that any correlation found between active travel and certain residential characteristics is likely to result from the choices made by people who enjoy being active to live in places that support their lifestyle preferences. In other words, higher active travel behaviours reflect lifestyle preference more than other drivers (it should be noted self-selection has only been raised in relation to physical activity, that is, no known studies have thus far suggested people who like fast food move to areas where there is a ready supply!). There is evidence that some self-selection probably does exist (Boone-Heinonen et al 2011). However, the concept itself is not without considerable problems. It assumes people have large amount of choice about where they live and make rational decisions based on in-depth prior knowledge of potential neighbourhoods; both issues are debatable. In the UK residential choice, particularly for many in society, for example those on lower incomes or those seeking to enter the housing market for the first time, is very limited. Furthermore, other factors such as access to good schools (for families with school age children) or social networks, are potentially more important in housing choice.

Some people will pursue a sedentary lifestyle no matter how supportive of an active lifestyle their neighbourhood happens to be. However, this misses the point: there is compelling evidence that people in the UK will walk considerable distances, even where conditions are far from ideal, to use local shops, services and open spaces (Townshend and Lake 2011; Barton et al 2012). How much more walking people would do if their neighbourhoods were made *more* supportive of walking might only be guessed at, but this cannot be ignored in future development.

## **CAPTURING COMPLEXITY: ENVIRONMENTAL FACTORS AFFECTING CHILDREN'S WEIGHT**

In 2010 a research project was established at Newcastle University which sought to examine the relationship between the prevalence of being overweight and obese and factors within the broad environment (land use, school, home etc.), for children aged 10-11 years. The study explored the ways in which environmental factors affect energy balance and adiposity among the target age group, taking into account dietary behaviour (the acquisition of, types and amounts of foods eaten) and physical activity behaviour (leisure activity, within education and commuting).

### **Methods**

A mixed methods approach was employed in the study, with quantitative analysis of behaviours and environmental features (using validated tools) and qualitative analysis to provide explanatory description. After an initial pilot study to test the efficacy of methods,

eight primary schools were recruited to the main study, the Children's Neighbourhood Environment Study (CNES), based on obesity rates (National Obesity Observatory 2011) and Index of Multiple Deprivation (IMD) scores, divided into quintiles. Four schools each representing the highest and lowest quintiles by obesity prevalence and IMD score were recruited to the study during two phases – winter (2011) and summer (2012). Fifteen randomly selected children (aged 10-11) were then recruited to the study from each school. The children self-reported physical activity and dietary intake using a four day diary that was designed and tested during the pilot study phase. The diary recorded activity type, intensity, location and any companions. In relation to food intake, the diary recorded items, time consumed and food source (the participants also photographed their activity and food). Participant's anthropometric measurements were taken. Participant and parental perceptions of their neighbourhood environments, physical activity, home food environment and diet were assessed, using questions adapted from validated surveys (Birch et al 2001; Davison et al 2003; Saelens et al 2003; Davison and Jago 2009; Lake et al 2009; Rosenberg et al 2010; Davison et al 2011). The participant's neighbourhood environment was subjected to a standardised audit within a 400m buffer of participant's homes. Details were recorded of parks and green spaces, sports facilities, non-food shops and services, food outlets, food advertising, roads and streets (length, safety, quality) and cyclability.

## **Findings**

Associations between BMI and neighbourhood parks and green spaces, shops and services, road length and safety and street length were in the direction expected (that is, favourable neighbourhood features correlated with lower BMIs). However, neighbourhood sports facilities, cycling facilities and street quality showed a counter-intuitive direction of

association with BMI, that is, higher BMI measurements. The direction of association between physical activity and neighbourhood greenspace, road and street length, sports facilities (not leisure centres) and cycling facilities was in the direction expected (that is, favourable neighbourhood environment features and higher physical activity). Conversely neighbourhood shops and services, leisure centres, road safety and street quality showed counter-intuitive direction of association with physical activity. Dietary intake showed no significant associations with neighbourhood environment.

The participant and parent perceptions of the neighbourhood environment, comprising shops and services, leisure facilities, food outlets and walkability, did not consistently correlate with each other or objective measurement.

Group level analysis was complex and potentially skewed due to the high level complexity of neighbourhood environments. In the existing obesogenic environment literature there is an at times unwritten assumption that neighbourhoods fall into inherent ‘types’, comprising an (un)healthy food environment, high/low walkability and the (non)promotion of leisure pursuits. What this study found was: ‘types’ are, in most cases, neither *fully*, nor even *scaled along a continuum between*, healthy and unhealthy across all measures within that type (for example, a neighbourhood may contain predominately healthy food outlets but the closest outlet is an unhealthy outlet – the measure used would consequently result in differing conclusions). And ‘types’ are not mutually exclusive (for example, a neighbourhood may be highly walkable but contain no leisure facilities).

The 400m buffers fail to capture the highly complex nature of neighbourhood environments which may have pockets of similarity, but taken holistically may not represent the sum of their parts; for example see Figure 14.4 which contains four distinct areas or types: industrial, out-of-town shopping, traditional housing with dispersed access to shops and services and a traditional high street. These issues of *type* and *buffer* are compounded by the incoherence between *perception* and objective environment audit. This issue may be attributable to the varying understanding and definition of what constitutes a ‘neighbourhood’, in which case it could be mitigated by taking alternate measures of the neighbourhood environment, that is, using GPS loggers<sup>ii</sup> which track actual environmental exposure. We would therefore recommend such approaches for further investigation.

The overall conclusion from the Newcastle study is that there is much research that needs to be undertaken to better comprehend the multi-faceted nature of environmental influence on both health behaviours and outcomes.

**(Figure 14.4 here with key which is saved as separate file (File name: Townshend Lake Figure 14.5Legend))**

**Figure 14.4: Overweight female participant 400m buffer neighbourhood environment**

**Source: authors**



## DISCUSSION AND CONCLUSIONS: THE ROLE FOR PLANNING

The key message from this chapter is that the role of the built environment in the obesity crisis is multifactorial and highly complex. Obesity is a very complex condition in itself, the built environment is even more complex in its variety – places are by definition unique and no matter how similar, no two are exactly the same. Drawing out the links between obesity and the built environment is, therefore, extremely difficult. However, as stated at the opening to this chapter, Foresight suggests there is enough evidence to implicate the built environment (2007). We would accept this and note the importance of Laurence’s concept of trans-disciplinarity (see chapter 6). However, this concept is undoubtedly challenging to those academics who are too deeply enmeshed within their planning or public health silos.

Reuniting health and planning, through the new public health responsibility for local authorities and the requirement for planners to work with public health organisations to address local health priorities, *should* bring the opportunity to look at the issue of evidence *across* the disciplines *and* at the local level. However, this will be dependent on the capacities of each partner to reach out and grasp the perspective of the other – strong leadership and commitment will be required.

New policies which are emerging around fast food outlet proliferation are an encouraging first step. The fact that planning decisions made in line with these policies in England have been overturned at appeal, however, brings the evidence debate sharply into focus. It suggests that authorities with planning responsibilities need to be meticulous about how such policies are worded, evidenced, applied in practice and the weight these policies carry in any particular planning system. Policies should, therefore, be as robust as possible, be *core* to

planning aims and objectives and statutory, wherever possible, rather than supplementary, or dispensed in optional ‘guidance’.

More generally, planning policy needs to translate the promotion of healthy and sustainable places into an on-the-ground reality. This needs a holistic and comprehensive approach and while obesity is not the *only* contemporary health issue of concern, what holds true for obesity amelioration is likely to have other health benefits, both physical and mental. We are entering the realm here of co-benefits, this is not a zero-sum game. There are other drivers promoting the need to support active travel, provide local shops and services as well adequate greenspace and general ‘greenery’ in neighbourhoods – while at the same time tackling those toxic services that have embedded themselves in many traditional shopping areas. As outlined in this chapter, this is much more easily said than done; however, planning policy and practice must be reviewed and looked at in terms of how it can support this public health imperative. Where concerns are found planning must change now if further harm is to be avoided. For even if those influences of the built environment are small at the individual level, taken over whole communities and across generations, they are decidedly significant.

## References

- Alaimo, K., Packnett, E., Miles, R.A. and Kruger, D.J. 2008. Fruit and Vegetable Intake among Urban Community Gardeners. *Journal of Nutrition Education and Behavior*. 40(2), pp. 94-101.
- Barton, H., Horswell, M. and Millar, P. 2012. Neighbourhood Accessibility and Active Travel. *Planning Practice and Research*. 27(2), pp. 177-201.

- Bell, A.C., Ge, K. and Popkin, B.M. 2002. The Road to Obesity or the Path to Prevention: Motorized Transportation and Obesity in China. *Obesity Research*, 10(2), pp. 277-283.
- Birch, L.L., Fisher, J.O., Grimm-Thomas, K., Markey, C.N., Sawyer, R. and Johnson, S.L. 2001. Confirmatory factor analysis of the Child Feeding Questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite*. 36(3), pp. 201-210.
- Black, J.L. and Macinko, J. 2008. Neighborhoods and obesity. *Nutrition Reviews*. 66(1), pp. 2-20.
- Boone-Heinonen, J., Gordon-Larsen, G., Guilkey, D.K., Jacobs, D.R. and Popkin, B.M. 2011. Environment and physical activity dynamics: the role of residential self-selection. *Psychology of Sport and Exercise*. 12, pp. 54 – 60.
- Burgoine, T. and Monsivais, P. 2013. Characterising food environment and exposure at home, at work, and along commuting journeys using data on adults in the UK. *International Journal of Behavioural Nutrition and Physical Activity*. 10.
- Caspi, C.E., Sorensen, G., Subramanian, S.V. and Kawachi, I. 2012. The local food environment and diet: a systematic review. *Health and Place*, 18, pp. 1172 – 1187.
- Cetateanu, A. and Jones, A. 2014. Understanding the relationship between food environments, deprivation and childhood overweight and obesity: Evidence from a cross sectional England-wide study. *Health & Place*.
- Davison, K., Cutting, T. and Birch, L. 2003. Parents' activity-related parenting practices predict girls' physical activity. *Medicine and Science in Sports and Exercise*. 35(9), pp. 1589-1595.
- Davison, K.K. and Jago, R. 2009. Change in parent and peer support across ages 9 to 15 yr and adolescent girls' physical activity. *Medicine and Science in Sports and Exercise*. 41(9), pp. 1816-1825.

Davison, K.K., Kaigang, L., Baskin, M.L., Cox, T. and Affuso, O. 2011. Measuring parental support for children's physical activity in white and African American parents: The Activity Support Scale for Multiple Groups (ACTS-MG). *Preventive Medicine*. 52, pp. 39-43.

De Vries, S. 2010. Nearby nature and human health: looking at mechanisms and their implications. In Ward Thompson, C., Aspinall, P. and Bell, S. *Innovative Approaches to Researching Landscape and Health*. Abingdon: Routledge.

Delpuech, F., Maire, B., Monnier, E. and Holdsworth, M. 2009. *Globesity: A Planet Out of Control*. London: Earthscan.

Durand, C.P., Andalib, M., Dunton, G.F., Wolch, J. and Pentz, M.A. 2011. A systematic review of built environment factors related to physical activity and obesity risk: implications for smart growth urban planning. *Obesity reviews*. 12, pp. e173-e182.

Foresight. 2007. *Tackling Obesities: Future Choices – Project report*. London. [Online]. Available at: [http://www.foresight.gov.uk/Obesity/obesity\\_final/17.pdf](http://www.foresight.gov.uk/Obesity/obesity_final/17.pdf).

Giles-Corti, B., Broomhall, M.H., Kniuman, M., Collins, C., Douglas, K., Ng, K., Lange, A. and Donovan, R.J. 2005. How Important is Distance To, Attractiveness, and Size of Public Open Space? *American Journal of Preventive Medicine*. 28(2S2), pp. 169 - 176.

James, W.P.T., Jackson-Leach, R. and Rigby, N. 2010. An International Perspective on Obesity and Obesogenic Environments. In Lake, A.A., Townshend, T.G. and Alvanides, A. (eds.) *Obesogenic Environments: Complexities, Perceptions and Objective Measures*. Oxford: Wiley-Blackwell.

Lake, A. and Townshend, T. 2006. Obesogenic environments: exploring the built and food environments. *The Journal of the Royal Society for the Promotion of Health*. 126(6), pp. 262-267.

- Lake, A., Tyrrell, R. and Greenhalgh, F. 2009. *7th International Conference on Diet and Activity Methods*. Washington DC, 5-7 June.
- Lake, A.A., Townshend, T.G. and Burgoine, T. 2014. Obesogenic Environments in Public Health Nutrition. In Lanham-New, S. (ed.). *The Nutrition Society Textbook Series*. Oxford: Wiley-Blackwell.
- London Borough of Barking and Dagenham. 2009. *Saturation Point: Addressing the health impacts of hot food takeaways. Draft Supplementary Planning Document*. London.
- London Borough of Brent. 2012. *Food for Thought: A Food Growing and Allotments Strategy for the London Borough of Brent*. London.
- McCormack, L.A., Laska, M.N., Larson, N.I. and Story, M. 2010. Review of the Nutritional Implications of Farmers' Markets and Community Gardens: A Call for Evaluation and Research Efforts. *Journal of the American Dietetic Association*. 110(3), pp. 399-408.
- National Obesity Observatory. 2011. *Child obesity and its determinants: Single map e-atlas. Middle Super Output Area (MSOA) level data*. Available at: <http://www.sepho.nhs.uk/noo/msoa/singleatlas/atlas.html> (Accessed: 11/5/11).
- Reynolds, K., Gu, D., Whelton, P.K., Wu, X., Duan, X., Mo, J., He, J. and For the Inter, A.C.G. 2007. Prevalence and Risk Factors of Overweight and Obesity in China. *Obesity*, 15(1), pp. 10-18.
- Rosenberg, D., Ding, D., Sallis, J.F., Kerr, J., Norman, G.J., Durant, N., Harris, S.K. and Saelens, B.E. 2010. Neighborhood Environment Walkability Scale for Youth (NEWS-Y): Reliability and relationship with physical activity. *Preventive Medicine*. 49(2-3), pp. 213-218.
- Saelens, B.E., Sallis, J.F., Black, J.B. and Chen, D. 2003. Neighborhood-Based Differences in Physical Activity: An Environment Scale Evaluation. *American Journal of Public Health*, 93(9), pp. 1552-1558.

- Smith, D., Cummins, S., Clark, C. and Stansfield, S. 2013. Does the local food environment around schools affect diet? Longitudinal associations in adolescents attending secondary schools in East London. *BMC Public Health*. 13(70).
- Swinburn, B., Egger, G. and Raza, F. 1999. Dissecting Obesogenic Environments: The Development and Application of a Framework for Identifying and Prioritizing Environmental Interventions for Obesity\*1. *Preventive Medicine*. 29(6), pp. 563-570.
- Tilt, J.H., Unfried, T.M. and Roca, B. 2007. Using objective and subjective measures of neighborhood greenness and accessible destinations for understanding walking trips and BMI in Seattle, Washington. *American Journal of Health Promotion*. 21(4), pp. 371 - 379.
- Townshend, T.G. 2014a. Walkable Neighbourhoods Principles, Measures, and Health Impacts. In Cooper, R., Burton, E. and Cooper, C.I. (eds.). *Wellbeing and the Environment: Wellbeing: A Complete Reference Guide, volume II*. Chichester: John Wiley & Sons.
- Townshend, T.G. 2014b. Warning! Toxic High Street. *Town and Country Planning*. 83(4), pp. 107-109.
- Townshend, T.G. and Lake, A.A. 2009. Exploring obesogenic urban form, Theory, policy and practice Health and Place. *Health and Place*. 15(4), pp. 909-916.
- Townshend, T.G. and Lake, A.A. 2011. Relationships between ‘Wellness Centre’ use, the surrounding built environment and obesogenic behaviours, Sunderland, UK. *Journal of Urban Design*. 16(3), pp. 351-367.
- van den Berg, A.E., van Winsum-Westra, M., de Vries, S. and van Dillen, S. 2010. Allotment gardening and health: a comparative survey among allotment gardeners and their neighbors without an allotment. *Environmental Health* 9(74).
- WHO. 2000. *Obesity: Preventing and Managing the Global Epidemic Technical Report Series 894*. Geneva.

WHO. 2003. *Diet, Nutrition and the Prevention of Chronic Disease. Technical Report Series 916*. Geneva.

---

<sup>i</sup> Other measures have included hip to waist ratio and adiposity (body fat), and as a consequence, comparisons between research using different measures can be difficult to interpret, particularly for non-specialists.

<sup>ii</sup> That is GPS devices worn by participants to show exactly where and what they access.